CAMBRIDGE
International Education

# Cambridge O Level

**COMPUTER SCIENCE** **2210/12**

Paper 1 Theory **May/June 2026**

MARK SCHEME

Maximum Mark: 75

**Published**

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **17** printed pages.

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**General marking principles**

All examiners must apply these marking principles when marking candidate responses.

| | |
|---|---|
| 1 | Examiners must award marks for each response in line with:<br><br>• the specific **content** defined in the mark scheme<br>• the specific **skills** defined in the mark scheme or in the level descriptions<br>• the **standard of response** required as exemplified by the standardisation scripts. |
| 2 | Examiners must award **whole marks** (not half marks, or other fractions). |
| 3 | Examiners must award marks **positively**. This means that:<br><br>• marks are not deducted for errors or omissions<br>• marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate<br>• the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous. |
| 4 | Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly. |
| 5 | Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen. |
| 6 | Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions in mind. |

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**Annotations guidance for centres**

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

**Annotations**

| Annotation | Meaning |
|---|---|
| ✓ | Correct point |
| ✗ | Incorrect point |
| ? | Unclear response |
| FT | Follow through |
| REP | Repetition |
| I | Ignore |
| BOD | Benefit of doubt given |
| NBOD | Benefit of doubt not given |
| TV | Content of response too vague |
| NAQ | Not answered question |

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| Annotation | Meaning |
|---|---|
| λ | Omission |
| | Section not relevant |
| | Section incorrect |
| Highlighter | Information copied from the text |
| SEEN | Page or response seen by examiner |

**Mark scheme abbreviations**

| | |
|---|---|
| **/** | separates alternative words / phrases within a marking point |
| **//** | separates alternative answers within a marking point |
| **underline** | actual word given must be used by candidate (grammatical variants accepted) |
| **max** | indicates the maximum number of marks that can be awarded |
| **( )** | the word / phrase in brackets is not required, but sets the context |
| **MP** | mark point |

**Note:** No marks are awarded for using brand names of software packages or hardware.

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(a) | A | **1** | If more than one box ticked, no mark can be awarded. |
| 1(b) | Bit(s) | **1** | Mark first answer given. |
| 1(c)(i) | A | **1** | If more than one box ticked, no mark can be awarded. |
| 1(c)(ii) | 00100000 | **1** | Mark first answer given.<br><br>Leading zeros must be present.<br><br>If the answer line is left blank, then an obvious correct answer can be awarded in the working space. |
| 1(c)(iii) | 11110010 | **1** | Mark first answer given.<br><br>If the answer line is left blank, then an obvious correct answer can be awarded in the working space. |
| 1(d) | **One** from:<br><br>• Accelerometer<br>• Light<br>• Temperature<br>• Proximity<br>• Infra-red<br>• Acoustic<br>• Magnetic field<br>• Moisture<br>• Humidity<br>• Pressure | **1** | Mark first answer given.<br><br>Motion, sound, touch and heart rate are TV.<br><br>If an answer is not in the list but seems viable, please refer to your TL.<br><br>Do not accept by description, for example it measures light. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2(a) | **One** from:<br><br>• To process/execute data/instructions<br>• To perform/carry out/run/process the fetch – decode – execute/FDE/FE cycle | **1** | Tasks/programs/code/information in place of instructions is TV.<br><br>MP2 – BOD do/does the FDE cycle |
| 2(b) | **Two** from:<br><br>• Program counter // PC<br>• Current instruction register // CIR // instruction register // IR<br>• Accumulator // ACC | **2** | Mark first answer given.<br><br>Do not accept MAR or MDR as they are given in the question.<br><br>Accept correct registers that are not on the spec e.g. index register // IX or status register // SR |
| 2(c) | **Three** from:<br><br>• The MAR **stores**/**holds/contains** the address/location/pointer // address is **sent**/**copied** to MAR …<br>• … for the value/data that is to be fetched/in RAM<br>• The MDR **stores**/**holds/contains** the value/data // data is **sent**/**copied** to the MDR | **3** | MP2 and 3 - BOD instruction in place of value/data |
| 2(d) | **Two** from:<br><br>• 3 billion<br>• … is the (maximum) number of instructions / FDE cycles / FE cycles / clock cycles processed **per second** | **2** | Tasks/programs/code/information is TV for instructions<br>MP1 – accept 3 billion by calculation e.g. $3 \times 10^9$ or 3 000 000 000<br><br>MP2 – BOD clock ticks/pulses in place of cycles. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 3(a) | D | **1** | If more than one box ticked, no mark can be awarded. |
| 3(b) | • 0001 0101 0010<br>• 0011 0000 1111 | **2** | Only penalise missing leading zeros once.<br><br>If the answer line is left blank, then an obvious correct answer can be awarded in the working space. |
| 3(c) | • 475<br>• AE8 | **2** | Mark first answer given.<br><br>If the answer line is left blank, then an obvious correct answer can be awarded in the working space. |
| 3(d) | • 162<br>• 260 | **2** | Mark first answer given.<br><br>If the answer line is left blank, then an obvious correct answer can be awarded in the working space. |
| 3(e)(i) | • Header<br>• Trailer | **2** | Mark first answer given.<br><br>BOD head for header and trail for trailer. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 3(e)(ii) | **Three** from:<br><br>• It examines/analyses/searches packet to find the **destination IP** address // It reads the **destination IP** address for a packet<br>• It **sends/transmits/forwards** packet towards/to its **destination**<br>• It **determines/assigns/controls/selects** the **route/path** each packet takes<br>• … which is the **fastest/most efficient/shortest** route/path // which is the route with the **least traffic**<br>• Uses/updates a routing table<br>• … to keep track of the most efficient routes/paths<br>• Checks/updates the packets hop count/time to live/TTL<br>• … and disregards packets when they have reached their hop count | **3** | Do not accept generic statement like 'each packet takes a different path' if there is no reference to the router determining/assigning the path.<br><br>MP1 - Accept MAC address in place of IP address. With a LAN this would be used.<br><br>MP2 – must have reference to the router forwarding the packet to its destination. It isn't enough to just say router determines path for the packet to reach its destination. This would get MP3 but not MP2 as well.<br><br>MP3 and MP4 can be given for a single statement e.g. It determines the fastest route for a packet. This gets MP3 for determining the route and MP4 for it being the fastest.<br><br>MP4 – best path is TV |
| 3(f)(i) | **Two** from:<br><br>• It uses electromagnets<br>• It has platters (to store data)<br>• (Platters are) divided into tracks and sectors<br>• It has a read/write head/arm | **2** | Mark whole answer.<br><br>MP1 – uses magnets is TV, must be electromagnet |
| 3(f)(ii) | Solid-state // solid-state drive // SSD | **1** | Mark first answer given. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 3(g)(i) | **Two** from:<br><br>• They want to retain the **original** version (of the video) // **Original** version (of the video) can be recovered<br>• (The videos) will be the highest/high **quality** // The **quality** will not be reduced/will be retained // Artifacting will be less likely<br>• Storage space is not a concern // File sizes are small enough (with lossless) | **2** | Mark whole answer.<br><br>Accept MPs in reverse e.g. lossy would reduce the quality of the video<br><br>MP1 – It is NE to just say no data will be permanently removed/data is restored. This is NE for the question, it is just saying what lossless does.<br><br>MP1 – 'closer/similar to the original' is inaccurate, it is not closer to it, it will be the same as original when decompressed. |
| 3(g)(ii) | **One** from:<br><br>• Smaller **file** size<br>• The videos would use less storage/memory space<br>• The time taken to transmit the videos would be shorter // Faster transmission/upload/download<br>• Less bandwidth would be used to transmit the videos<br>• Video would be less likely to buffer when streaming | **1** | MP3 – BOD faster loading time |
| 3(g)(iii) | **Four** from:<br><br>• A compression algorithm is used<br>• … such as RLE<br>• Repeating **frames/pixels** are identified …<br>• Repeating **samples** are identified (for sound) …<br>• … and indexed // by example<br>• Eliminating redundancy // Uses temporal redundancy<br>• … by recording the differences between each frame/amplitude (for sound) | **4** | MP3 and MP4 - Repeating data/patterns is TV<br><br>MP5 is dependent on either MP3 or MP4.<br><br>Accept others that are correct for other lossless methods, for example Huffman encoding. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 4(a) | **One** mark for each correct parity bit.<br><br>• 1<br>• 1<br>• 1 | **3** | Mark first answer given. |
| 4(b)(i) | **Two** from:<br><br>• A transposition error has occurred // Bits have been interchanged/changed **places** // **Even** number of bits has flipped/changed // bits are out of order // doesn't record the location of bits<br>• … so count/total of the 1s/0s in the byte is still **odd/the same** // still has an **odd** number of 1s/0s<br>• … so it will still meet the parity set | **2** | BOD data in place of bits<br><br>MP1 – Even number of errors is TV<br><br>MP2 – number of 1s is correct is NE |
| 4(b)(ii) | **Two** from:<br><br>• Parity **block** check<br>• **Even** parity (byte) check<br>• Checksum<br>• Echo check<br>• Automatic repeat query/request // ARQ | **2** | Mark first answer given.<br><br>Do not accept check digit. This is for data entry and not transmission. Context is about transmission.<br><br>Accept error detection methods not listed in the syllabus e.g. cyclic redundancy check. If unsure, refer to TL. |
| 4(c)(i) | **One** from:<br><br>• Symmetric // synchronous<br>• Asymmetric // asynchronous | **1** | Mark first answer given.<br><br>Accept by example e.g. public and private key encryption<br><br>Do not allow protocols that use encryption e.g. SSL. This is not a method of encryption. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 4(c)(ii) | **One** from:<br>• A string of **characters/numbers** used to encrypt data<br>• Used by an **algorithm**/**cipher** (to encrypt/decrypt the data) | **1** | MP2 – Accept 'It is an algorithm/cipher' |
| 4(c)(iii) | Cipher/cypher text | **1** | Mark first answer given.<br>BOD 'cipher' alone or 'cipher data' |

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5(a)</td><td>One mark for each missing term or description.
<table>
<tr><th>term</th><th>description</th></tr>
<tr><td>brute-force attack</td><td>An attack where a third party repeatedly tries to crack a password by entering different combinations.</td></tr>
<tr><td>hacking</td><td>A person gains unauthorised/illegal access to a user’s device/account/system</td></tr>
<tr><td>distributed denial of service attack // DDoS</td><td>An attack where multiple computers send a large number of requests to a web server with the aim of crashing it.</td></tr>
<tr><td>spyware</td><td>(Malware) that is used to record/track/monitors the keypresses from a user’s device.</td></tr>
<tr><td>data interception // packet sniffing</td><td>A security threat where software is used to analyse data packets during transmission. Any packets that look useful are sent to a malicious third party.</td></tr>
</table></td><td>5</td><td>Hacking – stealing/changing data without permission is TV as no reference to gaining access to the device/account.<br><br>DDoS – BOD just ‘denial of service’/’DoS’<br><br>Spyware – just reference to it tracking the user’s activity/actions is TV.<br><br>Spyware – allow reference to other specific actions than key presses e.g. recording what is captured with webcam or tracking the user’s movements from the device’s GPS.<br><br>Data interception - BOD just ‘interception’ or ‘man in the middle’/’MITM’</td></tr>
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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 5(b) | **Five** from:<br><br>• They **limit/restrict** a user's **access** to data<br>• … by giving users **different permissions** // Users can be given **read only/read-write/no access/execute/administrator** permission<br>• … so an attacker will **only** have access to the data that the **user** has access to<br>• … to stop a **malicious person**/**attacker deleting**/**editing/corrupting** data<br>• Prevents a user/attacker from installing malware (as they don't have administrator permissions)<br>• Prevents user/attacker from viewing more **confidential/important** data | **5** | MP1 – BOD controls access to data<br>MP1 – Accept a viable example e.g. a junior employee cannot access customer information<br><br>MP2 – 'different access levels' is TV for different permissions<br><br>MP2 – Accept any reference to a named permission. Just low-level or high-level access is TV.<br><br>MP5 – BOD download in place of install<br><br>MP6 – Accept an example of confidential data e.g. prevents attacker seeing the company financial accounts. Personal data is TV for an example of confidential data. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 6(a) | **Three** from:<br><br>• Image is **broken down**/**divided** into **pixels**<br>• Each pixel is a **single/one** colour<br>• Each **colour**/**pixel** has a **binary** value | **3** | Do not accept reference to resolution and colour depth. They are not directly relevant to the question.<br><br>MP1 – BOD 'made up' or 'grid of' or 'converted into' for broken down<br><br>MP1 – Just any reference to the image having/consisting of pixels is NE. It needs to clearly state that the image is broken down etc. into pixels. |
| 6(b) | **Four** from:<br><br>For example:<br><br>• It can use machine learning<br>• … by **adapting** its **own data/rules/processes**<br>• It can use image recognition<br>• It can **analyse/identify** the **patterns** (in different flowers)<br>• It can use **feedback from user/human**<br>• … to **identify/store successful**/**unsuccessful** identifications<br>• It can be **trained** by being shown pictures of flowers …<br>• … to learn in more detail/new characteristics of flowers | **4** | MP2 – Just 'it can learn and adapt' is NE.<br><br>MP3 - Accept other references outside the syllabus to AI that could be used to improve e.g. neural networks.<br><br>MP5 – 'learn from past results/mistakes' is TV.<br><br>MP5 – BOD reference to feedback being manual in place of 'from user' |
| 6(c)(i) | **One** from<br><br>• The app data won't take up **storage** space on their device // There will be more **storage** space on the device for other files<br>• They don't need to download the data each time they get a new device<br>• The data can be accessed from any device they use // The data is still accessible if their device breaks/is lost | **1** | Mark whole answer.<br><br>Do not accept answers relating to not needing to maintain hardware or security, or it having unlimited storage. These are not relevant to the scenario given.<br><br>MP3 – Can be accessed anywhere is TV. They could access it anywhere if it was stored on their phone. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 6(c)(ii) | **Two** from:<br><br>• Need an internet connection to access the data stored in the cloud // If internet is slow/unstable app could be difficult to use<br>• If the cloud storage is down/broken/fails the app cannot be used/access to data is lost<br>• Relies on a third party to keep any (personal) data secure/safe/private that is provide to the app // (personal) data stored by the app could be less secure/safe/private<br>• Access speed to the data may be slower/more limited (than stored locally) | **2** | Mark whole answer.<br><br>Do not accept answers relating to cost of cloud storage. This is not relevant to the scenario.<br><br>MP1 – Wi-Fi/network connection is TV<br><br>MP4 – BOD transmission speed may be slower |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 7(a) | A language that is closer to the language processed/used by a computer<br>// A language that is closer to binary/machine code<br>// A language has that little abstraction from that processed by a computer | 1 | Do not accept 'understood' in place of processed/used.<br><br>'it uses/is binary' is TV for it is closer to binary.<br><br>Do not accept that it is a language that uses mnemonics. This is not answering this question as not all do.<br><br>Do not accept benefits e.g. it can directly manipulate the hardware. This is not answering the question.<br><br>Do not accept marks for saying what it is not e.g. It is not close to human language. |
| 7(b) | **Two** from:<br><br>• Assembly (language)<br>• Machine code // Binary<br>• Object code | 2 | Mark first answer given.<br><br>MP2 – BOD machine language |
| 7(c) | Assembler | 1 | Mark first answer given. |
| 7(d) | **Two** from:<br><br>• The program doesn't need to be portable<br>• Can **directly manipulate/access** the hardware // Can have low-level **control** of the device<br>• The program will be faster to **execute/run**<br>• The program can be written for **specific** hardware // Can use/access **specialised** hardware<br>• The program uses **memory** more **efficiently** // The program is less memory intensive<br>• The program would take up less **storage** space (in the vending machine) // The **file size** would be smaller (than the high-level equivalent file) | 2 | Mark whole answer.<br><br>MP2 – program can communicate with hardware is TV as high-level language can also do this. There is no reference to it being direct.<br><br>MP3 – Less time to translate is NE for execute<br><br>MP5 – uses less space in memory is TV |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 7(e) | • Auto-correction<br>• Run-time environment<br>• PrettyPrint | **3** | Mark first answer given. |

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